SECTION 6
GOVERNOR'S COMMISSION CONCEPTUAL PLAN FOR THE RESTUDY

This section describes the development of the *Conceptual Plan for the Restudy*, which was developed by the Governor's Commission for a Sustainable South Florida. The Water Resources Development Act of 1996 directs that the conceptual framework provided in the *Conceptual Plan for the Restudy* (GCSSF, 1996b) be considered in the development of the Comprehensive Plan. The acknowledgement of the Commission that hydrologic restoration is the key and a prerequisite to ecosystem restoration led to the development of the Conceptual Plan: the vehicle to specifically address water resource issues and natural system restoration. That document provided a framework for the formulation and evaluation of alternative plans for the Restudy. Most of the information in this section was taken directly from the *Conceptual Plan for the Restudy* published by the Commission.

6.1. GOVERNOR'S COMMISSION FOR A SUSTAINABLE SOUTH FLORIDA

On March 3, 1994, Governor Lawton Chiles created the Governor's Commission for a Sustainable South Florida through the Governor's Executive Order 94-54. The Commission's charge was to make recommendations that will move south Florida toward a healthy ecosystem that can coexist with, and be mutually supportive of, a sustainable south Florida economy and quality communities. This Commission consists of business, agriculture, government, public interest, and environmental organization representatives. A number of Federal agencies are represented on the Commission as non-voting members. Toward this end, the Commission unanimously adopted two successive documents: the *Initial Report,* (GCSSF, 1995) containing overall recommendations for a sustainable South Florida; and, *A Conceptual Plan for the C&SF Project Restudy*, (GCSSF, 1996b), which provided initial recommendations for the Restudy.

6.2. INITIAL REPORT

The Commission's *Initial Report* (GCSSF, 1995) contained 110 recommendations with a central theme of sustainability – meeting the needs of the present without endangering the ability of future generations to meet their needs – revolving around the management of water. In that report, the south Florida ecosystem was defined as a community of organisms, including humans, interacting with one another and the environment in which they live. The Commission recognized

that *"Our quality of life is inextricably linked to the health and viability of natural systems"* and *"that a healthy Everglades system is vital to natural plant, animal and human population alike."* The Commission also unanimously agreed that the south Florida ecosystem is not sustainable on its present course.

Many of the recommendations in the *Initial Report* addressed the need to integrate all elements of water resource management including: water supply, flood protection, water quality, and natural resources restoration, protection and management. In addition the *Initial Report* also addressed a number of Restudy-related recommendations (see ***Table 6-1***).

TABLE 6-1
INITIAL REPORT: RESTUDY RECOMMENDATIONS

- The Corps and the District should "assure that the Restudy addresses the need to achieve a sustainable south Florida economy by ... proposing reliable, cost-effective measures to provide the necessary water supply." (Recommendation 11)
- "The Commission should provide a mechanism to enable input and integration of the state's concerns and interests with the U.S. Army Corps of Engineers and the south Florida Ecosystem Restoration Task Force in the Restudy and other Federal activities." (Recommendation 12)
- The Corps and the District should: "(1) address water supply needs for urban and agricultural users; (2) address natural water level fluctuations within the natural system and restoration of natural water quality, timing, volumes, and distribution to the Everglades; and (3) expedite the Restudy schedule without sacrificing thoroughness or quality of the final product." (Recommendation 13)
- "The Restudy should integrate all elements of water management (water supply, flood protection, water quality protection, and natural systems management). Redesign should provide for sustainability for human and natural system requirements." (Recommendation 15)
- "All plans, and especially the Restudy, should assure that new demands do not adversely affect the sustainability of human and natural systems." (Recommendation 16)
- "In the Restudy, the South Florida Water Management District and the Corps should ensure that the redesign of the system allows for resilience for a healthy natural system." (Recommendation 17)
- The agencies and interested parties should "redesign and develop new operations for the south Florida water management system at all levels to conserve and sustain the natural system, to maximize the capture of stormwater, and to conserve water for the benefit of all users." (Recommendation 23)
- The Corps and the District "should reduce the extent of damage from flooding to human and natural systems." (Recommendation 27)

6.3. DEVELOPMENT OF THE CONCEPTUAL PLAN

The Commission's *Conceptual Plan for the Restudy* consists of a strategy for coordinating and implementing a number of the water resource projects in south Florida into a cohesive whole, ensuring that they are consistent with the Commission's goals for a sustainable south Florida. While some projects are in various phases of implementation, these projects, by themselves, do not result in restoration. The Commission identified the need for additional and integrated efforts. The on-going projects form a foundation from which they developed the *Conceptual Plan for the Restudy*. Because the entire C&SF Project is hydrologically linked, all water management activities impact one another. Therefore, the Commission believes that implementation of the ongoing projects and programs must be closely coordinated by sharing information as they proceed from planning and design through implementation and operation. These on-going efforts, while not intended to be all-inclusive, are included as elements of the thematic concepts.

6.3.1. Commission's Planning Objectives

In developing the Conceptual Plan, the Commission first formulated a number of planning objectives ranging from restoring fish and wildlife, to increasing water supply for urban, agricultural and natural areas, to improving coastal and marine conditions. The Commission's objectives fall into three general categories: ecologic, hydrologic, and socio-economic. The Commission believes that if these objectives can be achieved, the goals of restoring the ecological health of the natural areas (including adjacent watersheds and tributaries) and enhancing the region's economy and quality of life can be achieved. The 23 planning objectives are listed in ***Table 6-2.***

The ecologic planning objectives focus on restoring environmental quality to a system that has experienced a massive loss of natural resources. They aim to expand habitat through reclamation and to improve habitat quality and heterogeneity consistent with the characteristic mosaic habitat of the pre-drained Everglades and the coastal and associated marine ecosystems.

The hydrologic objectives focus on ensuring adequate water quality; water supply; timing of flows; flood control for urban, natural, and agricultural needs; restoring more natural hydropatterns, including sheetflow; regaining lost storage capacity; reducing per capita consumption; and encouraging water reuse to achieve the ecologic objectives stated earlier.

TABLE 6-2
GOVERNOR'S COMMISSION
GENERAL PLANNING OBJECTIVES FOR THE RESTUDY

ECOLOGIC
• Improve habitat quality and heterogeneity.
• Improve connectivity and reduce fragmentation of habitats.
• Provide the spatial extent of natural areas required to support the mosaic habitat characteristic of the pre-drained Everglades ecosystem.
• Improve and protect habitat quality, heterogeneity, and biodiversity in coastal and associated marine ecosystems.
• Provide for sustainable populations of native plant and animal species with special attention to threatened, endangered, or species of special concern.
• Restore and, where appropriate, improve functional quality of natural systems (including both wetlands and uplands).
• Reduce the spatial extent of invasive nonnative species to the extent that they do not affect the natural system.
• Halt and/or reverse the conditions causing the spread of native species that are threatening (and perhaps dominating) areas as a result of disturbances such as nutrient enrichment.
HYDROLOGIC
• Restore more natural hydropatterns, including associated sheetflow.
• Provide more natural quality and quantity, timing and distribution of freshwater flow to and through the natural Everglades.
• Provide more natural quality and quantity, timing, and distribution of freshwater flow to estuaries and coral reef ecosystems.
• Ensure adequate water supply and flood protection for urban, natural, and agricultural needs.
• Regain lost storage capacity.
• Restore more natural organic and marl soil formation processes and arrest soil subsidence.
• Improve water quality, including reduction of toxins, and ensure appropriate water quality consistent with designated uses including restoration and protection of the natural systems.
• Control saltwater intrusion into freshwater aquifers.
• Integrate the Project with local stormwater, wastewater, and other water management functions.
SOCIO-ECONOMIC
• Establish levels of provided flood protection in terms of frequency, depth, and duration.
• Reduce damages from flooding to public and private property.
• Provide water management that supports economic diversity and sustainability derived from the natural and developed systems.
• Enhance economic opportunities consistent with sustainable marine ecosystems.
• Protect and preserve cultural and archeological resources and values.
• Increase recreational opportunities consistent with sustainable natural systems.

Finally, the economic and social objectives provide for water management that supports economic diversity and sustainability for natural, agricultural and developed systems. The Commission believes the need to integrate regional water management systems with local stormwater, wastewater, and other water management functions must be considered when developing alternatives.

6.3.2. Preferred Alternatives

As a first step toward identifying the additional actions needed to develop the Conceptual Plan for the Restudy, the Commission considered 66 options/ideas formulated from a myriad of Federal, state, and local agencies; interest groups; and other members of the public. Many of these options had been evaluated to varying degrees during the reconnaissance phase of the Restudy and the South Florida Water Management District's Lower East Coast Regional Water Supply Planning effort. The ideas ranged from non-structural options to ones that require major structural modifications or additions to the existing C&SF Project. Five additional options were generated by members of the Commission.

Through a series of three workshops, the Commission considered and grouped the options together to form alternative plans. This process helped the Commission gain an understanding of the interrelationships among the various options and set the framework for determining which options had common support and which ones did not. Facilitated discussion allowed for a systematic review and screening of each option.

The result of this process was a list of 40 preferred options, to be evaluated as modifications to the C&SF Project. The Commission agreed to support these options for technical evaluation in the Restudy, although conditions or limits were placed on certain ones. The conditions were intended to clarify important issues and to provide specific recommendations describing the Commission's alternatives for consideration in the Restudy in more detailed study of these options. ***Table 6-3*** includes the list of the 40 preferred options and the conditions (in italics) placed on those options.

Fundamental general concepts pertaining to the 40 preferred options were:

- The burden and responsibility for water storage should be shared across the system.
- Water quality and treatment should be addressed and optimized throughout the system.
- The Commission supports projects in general that salvage, clean up, and reuse water.

TABLE 6-3
40 PREFERRED OPTIONS (With Conditions)

Kissimmee River Area including Native American Tribal Lands

- Kissimmee River Pool A Restoration
- Paradise Run Restoration
- Kissimmee Region - Water Treatment Areas – *Project design must address water quality concerns. Holding areas should be multi-purpose.*

Lake Okeechobee Area

- Maximize Lake Storage Without Environmental Harm - *No significant impacts to the littoral zone or water quality should be allowed. Damage to the east and west coast estuaries by the current regulation schedule must be addressed.*
- Restore More Natural Fluctuations of Lake Levels - *No significant impacts to the littoral zone or water quality should be allowed. Other state agencies (e.g., FGFWFC) should be involved.*
- Restoration of Kreamer, Torry, and Ritta Islands
- Lake Okeechobee - Aquifer Storage and Recovery (Aquifer Storage and Recovery) - *The maximum additional storage and cost effectiveness should be evaluated. Impacts to the littoral zone should be minimized.*

Everglades Agricultural Area (Everglades Agricultural Area)

- Everglades Agricultural Area - Water Storage Areas (Reservoirs) – *Sufficiency of land to accomplish storage should be based on need, science, and appropriate cost-benefit analysis. Up to the entire Talisman property should be considered as a target of opportunity for increased storage with any portions not needed returned to agriculture; additional areas may be considered as necessary. Land acquisitions should be made with willing sellers and in consultation with local landowners. The burden of water storage should be shared across the system.*
- Increase Groundwater Levels to Control Soil Subsidence

Lower West Coast including Caloosahatchee River

- Caloosahatchee - Water Storage Areas (Regional Attenuation/Reservoir Facilities) – *Locations of potential storage areas should be chosen in consultation with local landowners.*
- Caloosahatchee – Water Treatment Areas - *Project design must address water quality concerns. Holding areas should be multi-purpose and located in consultation with local land owners.*
- Restoration of Golden Gate Estates - *Consistent with the South Florida Water Management District's restoration plan.*
- Caloosahatchee - Aquifer Storage and Recovery - *The maximum additional storage and cost effectiveness should be evaluated. Impacts to the littoral zone should be minimized.*
- Remove Organic Sediment Deposits from Caloosahatchee Estuary - *Any such removal should be evaluated as to cost effectiveness; pollution impacts from removal process; sediment disposal; and how to prevent resiltation.*

TABLE 6-3 (continued)
40 PREFERRED OPTIONS (With Conditions)

Western Basin including Native American Tribal Lands
- Water Treatment Area for L-28 (Interceptor)

Upper East Coast Area (UEC)
- UEC - Water Storage Areas (Regional Attenuation Facilities) - *Locations of potential storage areas should be chosen in consultation with local landowners.*
- Stabilize St. Lucie Canal Banks
- Remove Organic Sediment Deposits from St. Lucie Estuary - *Any such removal should be evaluated as to: cost effectiveness; pollution impacts from removal process; sediment disposal; and how prevent resiltation.*

Water Conservation Areas (Water Conservation Areas) including Holey Land and Rotenberger Wildlife Management Areas
- Modify Water Conservation Areas to Create Contiguous Natural Area – *Restore the connectivity of the Water Conservation Areas to the maximum feasible extent consistent with the ability to maintain flood protection and habitat quality, and to replace, through storage in the overall system, any existing urban water supply that may be lost.*
- Modify each Water Conservation Areas to Enhance Wetland Habitat – *Habitat should be enhanced to the maximum extent feasible. Public water supply may be addressed through storage in the overall system, and flood protection should be maintained.*
- Remove Invasive Non-Native Plants

Lower East Coast Area
- Water Preserve Areas
- Seepage Control - *All methods should be considered and evaluated.*
- Saltwater Treatment (Reverse Osmosis, Blending) – *Employ only as a last resort. Cost effectiveness should be evaluated. The technology does not stand alone.*
- LEC - Aquifer Storage and Recovery - *Use in conjunction with storage in buffer areas. Cost effectiveness, technical feasibility, and water quality should be addressed.*
- Wastewater Reuse
- Raise Coastal Canal Stages Coupled with Increased Discharge Capacity
- Water Treatment Area for S-9
- Inter-connect Local Water Management Systems – *There should be shared costs and a clear delineation of responsibilities. The responsibility to solve regional concerns should be included.*
- Implement Southern L-8 Basin / Loxahatchee Slough - *There should be no negative environmental impacts. This option is an example of a project that could salvage, clean-up, and reuse water. It would require local governmental consultation and review in concert with the Restudy.*
- Lake Belt/Seepage Barrier - *All methods of seepage control should be considered and evaluated.*
- Remove Invasive Non-Native Plants (LEC)
- 8 ½ Square Mile Area - *The progress of the East Everglades 8 ½ Square Mile Area Study should be monitored. The western 1/3 to ½ should be bought by the public and included in the buffer.*
- Control Structure in C-4 Canal

TABLE 6-3 (continued)
40 PREFERRED OPTIONS (With Conditions)

Big Cypress National Preserve
- Modify L-28 and L-28 Tieback Levees to Restore More Natural Flows Through Big Cypress National Preserve – *Increased conveyance through Tamiami Trail from CR 951 to 40 Mile Bend and Loop Road should be included.*

Everglades National Park
- Degrade L-29 Levee and Raise Portions of Tamiami Trail
- Add More Culverts Under Tamiami Trail – *Includes the entire reach of Tamiami Trail.*
- Flamingo Road Improvements to Improve Hydrologic Flow
- Incorporate Water Quality and Supply into C-111 and Modified Water Deliveries Projects

Florida Bay/Biscayne Bay/Florida Keys
- Hydrologic Improvements in the Model Lands Basin in Dade County
- Hydrologic Improvements in North, Central, and South Biscayne Bay Basins in Dade County

6.4. CONCEPTUAL PLAN ELEMENTS

After reaching consensus on the 40 preferred options, the Commission asked for additional analysis and information in order to refine the preferred options for possible inclusion into the Conceptual Plan for the Restudy. As part of the Restudy, the Commission's preferred options were screened and a process for analyzing them further was developed. Due to the similarities in function, the 40 preferred options were grouped into 13 thematic concepts to form a broad-based Conceptual Plan for the Restudy. These concepts include the spectrum of the preferred options identified by the Commission but are less specific. By generalizing the concepts, the Commission hoped to provide the Restudy with sufficient information to evaluate the broad spectrum of options and the trade-offs among them without restricting development of new options. Together with the potential modifications to the C&SF Project contained in the 40 preferred options, these concepts must be viewed holistically, not individually, since they come together to form an overall vision for the Restudy. In addition, many of the concepts will serve multiple purposes. For example, storage areas can help supplement natural system needs as well as provide water supply for agricultural and urban areas. The Commission recognized the need for detailed analyses conducted as part of the Restudy to develop specific projects. However, the concepts that comprise the *Conceptual Plan for the Restudy* provide a basis for the formulation and evaluation of specific plans.

Table 6-4 identifies the various thematic concepts and illustrates how the 40 preferred options fit within these concepts. Table 6-4 also identifies ongoing projects and the Federal Agriculture Improvement Act of 1996 (P. L. 104-127, known as the "Farm Bill") priority projects that fit under these thematic concepts. In addition, Figure 6-1 schematically portrays many of the concepts in relative geographic locales.

TABLE 6-4
THEMATIC CONCEPTS
Includes Projects Underway and 40 Preferred Options (in *Italics)*

Concept 1 – Regional Storage Within the Everglades Headwaters and Adjacent Areas
Kissimmee River Restoration Project*
Upper Chain of Lakes – Operational Changes*
Caloosahatchee – Water Storage Areas
Upper East Coast – Water Storage Areas

Concept 2 – Lake Okeechobee Operational Plan
Lake Okeechobee SWIM Plan.*
Interim Lake Okeechobee Regulation Schedule Study*
Maximize Lake Storage Without Environmental Harm
Restore More Natural Fluctuations of Lake Levels

Concept 3 – Everglades Agricultural Area Storage
Everglades Construction Project – STAs*,**
Bolles And Cross Canal Project*
*Everglades Agricultural Area Water Storage Areas***

Concept 4 – Water Preserve Areas
East Everglades 8 ½ Square Mile Area*
*Water Preserve Areas***
Seepage Control
Lake Belt/Seepage Barrier
Control Structure in C-4

Concept 5 –Natural Areas Continuity
Experimental Program of Modified Water Deliveries to Everglades National Park (Shark River and Taylor Sloughs)*
C-111 Project*
Modified Water Deliveries to Everglades National Park*
Florida Bay Emergency Interim Plan (Taylor Slough Demonstration Project)*
Modify Water Conservation Areas to Create Contiguous Natural Area
Modify Each Water Conservation Areas to Enhance Wetland Habitat
Modify L-28 and L-28 Tieback Levees to Restore More Natural Flows through Big Cypress National Preserve to Everglades National Park
Incorporate Water Quality and Supply into C-111 and Modified Water Deliveries Projects
Degrade L-29 Levee and Raise Portions of Tamiami Trail
Add More Culverts Under Tamiami Trail
Seepage Control
Flamingo Road Improvements to Improve Hydrologic Flow.
Hydrologic Improvements in the Model Lands Basin in South Dade County **
8 ½ Square Mile Area**
Seminole Water Conservation Project*,**
Rotenberger/Holey Lands**

Concept 6 - Water Supply and Flood Protection for Urban and Agricultural Areas
South Florida Water Management District Water Supply Planning*
Saltwater Treatment (Reverse Osmosis, Blending)
Wastewater Reuse
Raise Coastal Canal Stages Coupled with Increased Discharge Capacity
Interconnect Local Water Management Systems
Implement Southern L-8 Basin / Loxahatchee Slough

Concept 7 – Adequate Water Quality for Ecosystem Functioning
Everglades Construction Project - STAs*,**
Advanced Water Quality Treatment Technologies - Research*
Seminole Water Conservation Project*,**
Miccosukee Water Management Area*,**
SWIM Plans*
Mercury Program*
State Water Quality Efforts*
Florida Keys National Marine Sanctuary Water Quality Protection Program*
Kissimmee Region – Water Treatment Areas
Caloosahatchee - Water Treatment Areas
Water Treatment Area for L-28 (Interceptor)
Water Treatment Area for S-9
Best Management Practices for Agriculture **
Lower Western Basin STA**

Note: Projects Underway noted by *; Governor's Commission for a Sustainable South Florida's Farm Bill Priority Projects noted by **

TABLE 6-4-(continued)
THEMATIC CONCEPTS
Includes Projects Underway and 40 Preferred Options (in *Italics*)

Concept 8 – Increase Spatial Extent and Quality of Wetlands Beyond the Everglades Kissimmee River Restoration* Lake Kissimmee Drawdown* Save Our Rivers Program* *Kissimmee River Pool A Restoration* *Paradise Run Restoration* *Restoration of Kreamer, Torry, and Ritta Islands* *Restoration of Golden Gate Estates*** South Dade Wetlands Addition** Fakahatchee Strand** Belle Meade** South Glades** **Concept 9 – Invasive Plant Control** *Remove Invasive Nonnative Plants from Water Conservation Areas* *Remove Invasive Nonnative Plants from Urban Areas* **Concept 10 – Aquifer Storage and Recovery** *Lake Okeechobee – Aquifer Storage and Recovery* *Caloosahatchee – Aquifer Storage and Recovery* *LEC – Aquifer Storage and Recovery*	**Concept 11 - Protection and Restoration of Coastal, Estuarine, and Marine Ecosystems** SWIM Plans* C-111 Project* Modified Water Deliveries to Everglades National Park* Florida Keys Carrying Capacity Study*,** Florida Bay Emergency Interim Plan (Taylor Slough Demonstration Project)* Florida Bay Hydrodynamic Model* Biscayne Bay Hydrodynamic Model* Florida Keys National Marine Sanctuary Water Quality Protection Program* *Remove Organic Sediment Deposits from Caloosahatchee Estuary* *Stabilize St. Lucie Canal Banks* *Remove Organic Sediment Deposits from St. Lucie Estuary* **Concept 12 - Conservation of Soil** *Increase Groundwater Levels in the Everglades Agricultural Area* **Concept 13 – Operation, Management, and Implementation of the C&SF Project Modifications and Related Lands**

Note: Projects Underway noted by *; Governor's Commission for a Sustainable South Florida's Farm Bill Priority Projects noted by **

The following sections provide a description of each of the concepts which include those projects currently underway or programmed and additional features the Commission determined important to meet its objectives for the Restudy. The description of the concepts is taken directly from the Commission's report. The thirteen concepts broadly covered four major themes: regional storage for natural systems, water supply and flood protection; natural areas enhancement and restoration; improved water quality; and improved operation, management and implementation practices.

6.4.1. Concept 1: Regional Storage Within The Everglades Headwaters And Adjacent Areas

Sufficient water to meet competing demands can only be provided by maximizing storage. Water storage should be provided throughout the entire system and in such a way that no single area is environmentally damaged by excessive storage requirements or bears a disproportionate share of the storage burden. This storage must be achieved in all areas of the south Florida system using every practical option. As part of this concept, regional storage would be evaluated for the northern reaches of the Everglades system (Caloosahatchee, St.

Lucie, and Kissimmee River Basins). The additional storage in these basins should increase the water supply capabilities of the system and could ultimately reduce demands on Lake Okeechobee, thereby providing additional water during the dry season and reducing damaging high water conditions and harmful discharges to the east-west estuaries during the wet season.

6.4.1.1. Kissimmee River Basin

The Kissimmee Chain of Lakes forms the headwaters of the Everglades system and provides a critical source of water for Lake Okeechobee. The Kissimmee River Restoration Project, as currently planned, includes operational changes of lake levels in Lakes Kissimmee, Hatchineha, and Cypress to increase storage capacity necessary for the restoration of the Kissimmee River. Additional efforts that should be considered under this concept include examination of the operational plans for the remainder of the Upper Chain of Lakes to discern if they could provide additional storage capabilities to benefit the health of Lake Okeechobee and potentially reduce the volume of water shortages in the system.

Additional storage within the Kissimmee River Basin could reduce the amount of runoff entering Lake Okeechobee during the wet season when the lake typically approaches high levels. This could shorten the duration of high water levels within the lake that damage its littoral zone and could reduce the frequency of high volume discharges to the east and west coast estuaries. The increase in water levels within the Upper Chain of Lakes could be restricted to avoid natural system impacts of high water levels and the need to maintain flood protection to lakeside residential development throughout the area. In support of the Commission's sociological and economic goals, this concept must be designed to balance the need for storage with the need to maintain flood protection to lakeside developments and should not result in the relocation of communities and agricultural areas.

6.4.1.2. St. Lucie Canal and Caloosahatchee River Basins

Creating additional storage or enhancing the storage capacity on existing private or public facilities and open areas within the St. Lucie Canal and Caloosahatchee River Basins may reduce water supply demands on Lake Okeechobee by providing a supplemental source of water for irrigation and environmental base flow for the estuaries. The water conserved in Lake Okeechobee could be available for sustaining the health of the lake and downstream natural areas and other uses. Storage facilities could also attenuate local basin runoff that presently upsets the salinity balance in estuaries and adversely impacts seagrasses, invertebrates, and fisheries.

Pumping local basin urban and agricultural runoff into storage areas could attenuate flows during the wet season and provide storage into the dry season.

Restoring hydropatterns in large natural areas and storing excess water in wet pastures could attenuate flows and help restore cleaner and more natural inputs to the estuaries. Restoration of natural areas can also help meet the goal of expanding and enhancing the spatial extent of short hydroperiod wetlands. Dry period releases from these storage areas could be used for agricultural irrigation and for meeting minimum flow requirements of the estuaries. During those periods when supplemental irrigation requirements could not be met by the storage areas, water supply releases from Lake Okeechobee could still be provided. Attenuating stormwater runoff will provide some water quality benefits, although additional treatment may be required depending on the use of the discharged water. Water clarity is very important to aquatic vegetation, particularly grasses. For example, storing stormwater may allow suspended solids to settle out, consequently improving the transparency of the water.

The storage areas and their associated water treatment facilities should be sized and designed to be ecologically consistent with the location. The total storage volume, coupled with the size and depth of the storage areas, need to be optimized as a part of detailed design during the Restudy. The storage areas could require perimeter levees, pump stations, and conveyance canals to move water from the canal system into the storage areas and to control water supply and environmental releases from the storage areas. Ideally, individual upland storage areas would be divided among the various sub-basins and would be interconnected to provide for maximum flexibility of water management options among basins. The siting of these facilities should, to the maximum extent practicable, avoid primary or secondary impacts to existing wetlands and adjacent uplands, both of which contribute to a viable ecosystem and economy. The Indian River Lagoon Feasibility Study is examining the option of on-site retention for large dischargers within the St. Lucie Basin not presently providing such facilities; this concept should be examined for other areas as part of the Restudy effort.

6.4.2. Concept 2: Lake Okeechobee Operational Plan

Lake Okeechobee provides a critical source of water for the Everglades Agricultural Area (EAA), the urbanized areas of the Lower East Coast, portions of the Lower West Coast, the remaining portions of the historic Everglades system, and other wetland components of the south Florida ecosystem. Prior to manmade alterations, lake levels rose in response to rainfall and served as a valuable source of freshwater spilling into the Everglades during a relatively small number of high rainfall years. Today a lake regulation schedule triggers different management activities according to different lake levels. The current regulation schedule, known as Run 25, was developed for multiple purposes including water supply, flood control, navigation, and environmental protection. Since some of these goals conflict, achieving all of them under current conditions is impossible. Past efforts to meet all of these conflicting goals have resulted in damage to the lake's littoral zone and to the east and

west coast estuaries. The Commission believes a new operational plan for the lake is needed that maximizes storage opportunities, protects the east and west coast estuaries, restores the ecological health of the lake, and enhances wildlife populations. The ability to accomplish these goals greatly depends on additional storage throughout the system and on other improvements to the overall C&SF Project.

Within the constraints imposed by these conflicts, the operational guidelines for Lake Okeechobee are currently being reviewed to attempt to optimize the natural resources within the lake, water discharges for the purpose of restoring the natural hydropattern of the Everglades, and flows to the estuaries without adversely impacting flood control or urban and agricultural water supply. Avoiding environmental harm to the St. Lucie and Caloosahatchee Estuaries caused by massive lake releases is an important goal. Equally important is protection of the lake littoral zone from prolonged high water. Maximizing storage for environmental, agricultural and urban needs while protecting the lake and estuaries will require creative new operational schedules. This interim study of operational guidelines for the lake is being conducted in conjunction with South Florida Water Management District's Lower East Coast Regional Water Supply Plan. In addition, the South Florida Water Management District's Surface Water Improvement and Management Plan requires specific regulatory and non-regulatory activities to address water quality conditions, including ongoing development and testing of agricultural Best Management Practices to reduce pollutants and assure water quality compliance for discharges into the lake. Additional actions may be necessary since current nutrient loads to the lake remain above the established target. Nutrient levels contained in lake water would need to be lowered before it could be discharged into the Everglades. These ongoing efforts should serve to benefit the health of the lake through improved water quality and operational changes which are more desirable for the lake's littoral zone without compromising other project purposes such as flood control and water supply. To fully resolve these conflicting demands on the lake, additional storage areas throughout the system and methods to improve water quality are required.

Until additional storage options are available elsewhere in the system, temporary storage capacity in the lake could help meet projected demands for urban and agricultural water supply and natural system needs. Revisions to the operational plan for Lake Okeechobee may allow additional water to be stored in the lake during wet periods and may help meet the projected demands during dry periods while maintaining ecologically desirable water fluctuations and lake levels. This could be accomplished by allowing periodic lower levels during droughts and higher water levels during wet periods, providing there is no significant adverse impact to the lake's littoral zone, or the east and west coast estuaries. A new operational plan needs to be identified that triggers management activities for high lake levels and "supply-side" management actions for low lake levels. Modified lake operations could increase the storage capacity of the lake, while reducing impacts to other parts of the regional system. All operational options that seek to increase lake storage capacity, while

protecting the littoral zone and the east and west coast estuaries, must be carefully examined.

Lake Okeechobee's littoral zone provides important nursery grounds and habitat for fish and other aquatic organisms. It also supports large populations of wading birds and migratory waterfowl. The current location of the littoral zone is the result of the construction of the existing dike system, and the lowering of the lake level by drainage. Colonization by aquatic plants creates a littoral zone where fluctuating water levels are sufficient to support emergent vegetation. A diverse littoral zone cannot survive under periods of prolonged inundation. Timing of varying water levels and light penetration in the shallows are key factors in maintaining a viable littoral zone. The existing littoral zone was established when lake regulation levels fluctuated between 13.0 and 15.5 feet NVGD. In 1978, the regulation schedule was set at 15.5 to 17.5 feet to increase lake water storage. Assuring the continued health of the existing littoral zone is an important goal. All available information should be used to design a lake regulation schedule that preserves a healthy littoral zone, maximizes lake storage, and allows attenuation of floodwaters to protect the east and west coast estuaries. If it is determined to be feasible, raising the regulation schedule above the current limits may require costly structural changes such as raising existing levees, modifying or adding water control structures, constructing new pump stations, canals, and tie back levees. Also, State Road 78 may need to be raised and additional flood easements acquired. Recent high lake levels and the resulting dike seepage problems indicate levee repairs and improvements may be required even if the current regulation schedule is not raised. In addition, the Seminole Tribe's Brighton Reservation is located on the northwest side of Lake Okeechobee. As Federal Trust Property, this reservation should be considered in any decision regarding modifications to the water levels of the lake. The Restudy must consider all of these aspects when evaluating the role that Lake Okeechobee will play in the future.

6.4.3. Concept 3: Everglades Agricultural Area Storage

Much of the supplemental water supply for the Everglades Agricultural Area in the dry season is currently met by deliveries from Lake Okeechobee. Additional water storage in the Everglades Agricultural Area will lessen its dependency on Lake Okeechobee for irrigation water and potentially reduce the ecologically damaging high water conditions in the Water Conservation Areas and backpumping into Lake Okeechobee during the wet season. Regional above-ground impoundments or storage areas within the Everglades Agricultural Area could capture and store Everglades Agricultural Area runoff or excess water from Lake Okeechobee during the wet season. During the dry season, reservoir releases could be made to the primary canals for agricultural irrigation and for restoration of the downstream Everglades ecosystem. Lake Okeechobee would then no longer serve as the only supplemental source for meeting Everglades Agricultural Area irrigation demands. During the

periods when supplemental irrigation requirements could not be met by the storage areas, water supply releases from Lake Okeechobee could still be provided.

The Commission recommends that the determination of sufficient land to accomplish storage in the Everglades Agricultural Area be based on need, science, and appropriate cost-benefit analyses. The Talisman property is currently being considered for acquisition by the State for use as a water storage area. The Commission supports the acquisition of up to the equivalent of the Talisman property as a target of opportunity for increased storage. Additional areas may be considered. Until the total storage volume, size, and depth of storage areas are designed and optimized during the Restudy, based on analyses of costs, benefits, needs, and impacts, all land acquisition should be made with willing sellers and in consultation with local landowners. Acquired lands could be returned to agricultural use if not needed for restoration activities.

Properly sized and designed storage areas have the potential of improving the quality of water being delivered to the natural system by reducing Everglades Agricultural Area runoff entering the stormwater treatment areas, thereby reducing the nutrient loading coming from the Everglades Agricultural Area and aiding the stormwater treatment areas in meeting target phosphorus levels entering the Water Conservation Areas. Further, detention of stormwater for attenuation purposes will improve water quality. However, additional water treatment may be required if the water within these storage areas is to be used to meet natural system demands.

Ongoing efforts to improve flood control capacity within the Everglades Agricultural Area and water quality of downstream flood control discharges, include the Everglades Construction Project and the reevaluation of the Bolles and Cross Canals. Presently, the design of the major canals of the Everglades Agricultural Area is constrained in moving water internally within the Everglades Agricultural Area or from Lake Okeechobee to the south. By incorporating expanded or modified Everglades Agricultural Area canals with stormwater treatment areas and new water storage areas, the increased operational flexibility could provide additional flood protection to the Everglades Agricultural Area while protecting the Water Conservation Areas and the coastal estuaries from damaging high water levels and untimely discharges. When Lake Okeechobee exceeds its regulation schedule, water that currently impacts the lake's littoral zone or disrupts the east and west coastal estuaries could be moved southward into new storage areas or, water quality permitting, to the Water Conservation Areas.

6.4.4. Concept 4: Water Preserve Areas

The purpose of the Water Preserve Areas concept is to: (1) increase storage and hold more water in the system by controlling seepage from natural areas; (2) capture and store excess stormwater currently discharged to coastal waters, thus retaining an

important water supply source for both urban and natural systems; (3) provide a buffer between the natural and developed areas; (4) preserve and protect wetlands outside the publicly owned Everglades; and (5) provide important transitional land uses between the natural and developed areas. The Water Preserve Areas concept may also enhance flood control in areas to the east of the Water Preserve Areas. Attempts to meet these various goals should be coordinated and developed in a consistent manner.

Hydrologic modeling of the regional system has demonstrated seepage control is a critical component for achieving restoration targets in the southern Everglades and Florida Bay. Much of the water that seeps out of the Everglades is collected in the secondary canal network and discharged into the regional canal system, resulting in excessive releases to coastal waters. The Water Preserve Areas concept must include a cost-effective implementation of one or all of these alternatives to achieve the multi-purpose functions and operational flexibility needed to meet the Commission's objectives. Water Preserve Areas should enhance regional capabilities for meeting environmental, urban, and agricultural water demands, while simultaneously providing protection of certain designated wetlands outside the Water Conservation Areas and Everglades National Park. The Water Preserve Areas concept consists of a series of surface water impoundments, interconnected and managed as a system of marshlands, storage areas, and/or aquifer recharge basins. These areas provide the potential to backpump stormwater currently discharged to coastal waters and serve to control urban sprawl into remaining peripheral wetlands. Some examples of seepage control alternatives which should be evaluated for inclusion in the Water Preserve Areas are creating areas to store excess urban runoff, creating a step down of water levels toward the east, building collection and backpumping facilities, and installing subterranean barriers.

Water quality becomes an important consideration where enhancement of existing wetlands or backpumping into the Water Conservation Areas or wellfield recharge areas is desired. Untreated stormwater should be diverted to a treatment facility or should undergo other treatment options necessary to achieve water quality standards prior to discharge to a wetland area, wellfield recharge area, or surface water supply source areas. In particular, the S-9 pump station must also be considered. The S-9 pump station is the only major C&SF Project facility that currently discharges untreated urban stormwater into the Everglades. Other urban stormwater discharge into the Everglades by local drainage districts must also be addressed. Structures that discharge into Water Conservation Areas should have appropriate permits to discharge effluent, should be monitored, and should meet all applicable state and Federal water quality standards and laws. A water treatment facility could remove phosphorus and other constituents from stormwater prior to discharge into the Water Conservation Areas.

The Water Preserve Areas concept includes the remaining natural areas and open spaces along the eastern boundaries of Everglades National Park and the Water Conservation Areas and extends north into the Upper East Coast area. This concept is considerably more extensive than the existing South Florida Water Management District East Coast Buffer Project boundaries, that is a land acquisition initiative that preserves, where possible, design flexibility for future water preserve elements. For example, Palm Beach County has proposed that the Water Preserve Areas concept be extended east and northeast into the Loxahatchee Basin.

In June 1995, the Martin and St. Lucie County Commissions established a Water Preserve Areas Task Force to facilitate selection of suitable sites for Water Preserve Areas in those counties. In Martin and St. Lucie Counties, Water Preserve Areas could provide for the diversion of surplus runoff from the C-23, C-24, and C-25 drainage basins to storage areas where the water could be used for agricultural purposes or, with treatment, could be discharged into the estuary to enhance needed baseflow. The Task Force has completed a draft report that evaluated a number of potential Water Preserve Areas sites and conducted a design charette for a potential site at Allapattah Ranch. Water Preserve Areas in these two counties could help alleviate the problems caused by excessive inflows of freshwater to the St. Lucie Estuary and Indian River Lagoon.

The area of northwestern Miami-Dade County proposed as a future "Lake Belt" by the South Florida Limestone Mining Coalition lies east of Water Conservation Areas-3B and comprises a large portion of land being considered for the Water Preserve Areas. The Florida Legislature recognized that one of the few remaining high-quality, construction grade limestone deposits suitable for the production of aggregates, cements and road base materials in the state is located in this area. Therefore, the legislature established the Northwest Dade County Freshwater Lake Plan Implementation Committee and further defined the proposed lake plan boundaries. The objective of the legislation is to develop a plan that:

> *"(a) enhances the water supply for Dade County and the Everglades; (b) maximizes efficient recovery of limestone while promoting the social and economic welfare of the community and protecting the environment; and (c) educates various groups and the general public of the benefits of the plan."*

A public/private partnership may offset the cost or reduce the need for acquiring portions of the Water Preserve Areas (including but not limited to land donations, land swaps, and less than fee simple acquisitions). However Lake Belt Plan development is proceeding in advance of the Water Preserve Areas design component of the Restudy. Coordination between these two planning efforts is necessary to avoid difficulties associated with Everglades restoration. It is important that the future lake plan be consistent with economic and environmental sustainability and flexible

enough to ensure compatibility with south Florida natural system restoration and other objectives set forth by the Governor's Commission.

The Water Preserve Areas concept should extend seepage control south of Tamiami Trail to the eastern panhandle of Everglades National Park including the 8 1/2 Square Mile Area and the C-111 Basin. The stretch of the L-31N from Tamiami Trail to the 8 1/2 Square Mile Area is of significant concern because of the extreme rates of seepage along the eastern border of Northeast Shark River Slough. Raising water levels in the L-31N Canal is a critical element in restoring hydropatterns in Everglades National Park. This cannot be achieved without seepage control due to the flooding threat to the 8 1/2 Square Mile Area and areas to the east of the L-31N Canal. One suggestion in support of the Water Preserve Areas concept is to install a divide structure in the C-4 Canal. This would increase the potential volumes of stormwater that could be captured by various backpumping configurations as well as help recharge wellfields and improve flood protection for urban areas.

Because the 8 1/2 Square Mile Area is located adjacent to the Everglades National Park boundary, flood control could affect restoration of natural hydropatterns, flows and water quality within the Park. The currently authorized flood mitigation for the 8 1/2 Square Mile Area does not provide adequate protection for the community. The 8 1/2 Square Mile Area deserves consideration by the Restudy, consistent with the recommendations of the Governor's Committee on the 8 1/2 Square Mile Area.

The exact extent, design, and operation of the Water Preserve Areas should be evaluated and determined as part of the Restudy. However, time is of the essence as lands in some of the proposed Water Preserve Areas are rapidly being converted to uses that are incompatible with their potential use as Water Preserve Areas. Therefore, The Commission believes that accelerated acquisition of critical lands is needed to ensure that this concept remains viable.

6.4.5. Concept 5: Natural Areas Continuity

Historic freshwater wetland habitats in south Florida have been reduced spatially, compartmentalized, and hydrologically altered as a result of the C&SF Project. Further, habitats have been unnaturally fragmented. Reestablishing the hydrologic and ecologic continuity of the remaining natural areas is expected to benefit the entire Everglades ecosystem by recovering the pre-drainage functions and habitat values of historic freshwater wetlands, reducing the fragmentation, and restoring more natural hydropatterns including associated sheetflow. These actions may also help restore the ecological processes and relationships, and the diversity and numerical abundance of animals that can only come by reestablishing the central and southern Everglades and Big Cypress into a single, fully integrated ecosystem. This concept proposes to restore ecological continuity to areas that are currently treated as

geographically and hydrologically distinct. These areas include the three Water Conservation Areas, the Rotenberger/Holey Land Wildlife Management Areas, the Big Cypress National Preserve, Ten Thousand Islands, Fakahatchee Strand, Mullet Slough, Corkscrew Swamp, Caloosahatchee Slough, Rookery Bay, Everglades National Park, the Model Lands, Florida Bay, the Florida Keys, and associated estuarine and marine waters. This concept involves structural and/or operational changes within the remaining natural areas for the benefit of the entire ecosystem. These structural changes should also include examining the effects and/or proposing changes to U.S. 27, which bisects the Water Conservation Areas, to enhance natural conditions.

Water quantity and water quality are important aspects of this concept, however, features to achieve these goals will generally come from outside the boundaries of the remaining natural areas. This concept assumes that appropriate quantity and quality of water needed to meet ecosystem goals in the natural areas will be available and that the Water Conservation Areas will be managed to the maximum extent feasible for natural values. Existing legislation by the State of Florida, the Everglades Forever Act, addresses non-point source pollution from agricultural activities in the Everglades Agricultural Area. Best Management Practices and treatment of runoff from the Everglades Agricultural Area through stormwater treatment areas are designed to reduce phosphorus levels in water released to the Everglades to 50 parts per billion, an interim goal for the discharges. Additional water quality treatment may be necessary if more stringent water quality standards are applied and additional water for restoration is required. Where possible, the Everglades Forever Act implementation schedule should also be accelerated.

Several efforts are currently underway that will help achieve the goals of restoring the hydrological function and reestablishing ecological connections between natural areas and wildlife communities. These ongoing projects include the Experimental Program of Modified Water Deliveries to Everglades National Park, the C-111 Project, and the Florida Bay Emergency Interim Plan (Taylor Slough Demonstration Project). The Commission believes implementation of these projects will help achieve these goals while maintaining and, where possible, improving levels of water supply and flood protection to the adjacent agricultural areas.

The Experimental Program of Modified Deliveries to Everglades National Park was initiated in 1984 to test alternative operational plans and to provide more natural hydrologic conditions in the Everglades during the testing process. Initial tests addressed water deliveries to Shark River Slough and have since incorporated tests of water deliveries to Taylor Slough. The program will continue through the design and construction of the Modified Deliveries to Everglades National Park and the C-111 Projects. The Modified Water Deliveries to Everglades National Park Project is aimed at restoring the original deep water portion of Shark River Slough and reducing the impacts of large flood releases in western Shark River Slough. The C-111 Project will

create a buffer area along the eastern boundary of the Park to allow increased water levels in Taylor Slough and gradually lessen water levels from west to east. C-111 Project design modifications should also ensure natural water deliveries to the panhandle area of Everglades National Park and the Model Lands area east of U.S. 1. In addition, the Florida Bay Emergency Interim Plan, required by the Everglades Forever Act, should increase the amount of freshwater reaching Florida Bay by acquiring the Frog Pond and raising canal stages to promote more freshwater to flow through Taylor Slough into Florida Bay. Flood protection will be maintained and, where possible, improved for adjacent, existing urban and agricultural lands as these projects are implemented. Results should be monitored to evaluate effectiveness or identify needed modifications. The goal is to replicate flows, more natural hydropatterns, and flows in natural areas to maintain and restore native wetland, upland plant communities, and wildlife communities.

In the development of this Conceptual Plan for the Restudy, the Commission identified additional efforts needed in the region to fully meet its objectives for hydrologically and ecologically reconnecting natural areas. These are described as follows:

6.4.5.1. Water Conservation Areas

Historically, the three Water Conservation Areas were an expansive mosaic of habitats including uplands, hammocks, sawgrass plains, wet prairies, sloughs, lakes, and marl-forming marshes that constituted the central and northeastern portions of the historic Everglades. Construction of the three Water Conservation Areas has resulted in the management of each of the areas according to a regulation schedule based on inflow and outflow of water through water control structures and system demands.

As part of this concept, structural modifications to the levees and structures currently compartmentalizing the Water Conservation Areas and changes in operational plans will be investigated for the purpose of restoring more natural hydrologic and ecologic continuity within all of the Water Conservation Areas. Preliminary hydrologic modeling conducted during the reconnaissance phase of the Restudy indicated some levees and structures may still be necessary to create desirable hydrologic and ecologic conditions throughout the area. Further, the current Water Conservation Areas regulation schedules need to be modified to schedules based on more natural conditions. The goal is to replicate more natural hydropatterns within the Water Conservation Areas and to maintain and restore native wetland and upland plant communities. It is important to note that the movement of water through these areas has been altered by soil subsidence. Current flow patterns are much different than historic flow patterns. For these and other reasons, more detailed hydrologic modeling is necessary to determine changes in hydrologic patterns that result from modifications to the amount, timing, and distribution of water flowing into

and through the Water Conservation Areas. As part of the Restudy, restoring the connectivity of the Water Conservation Areas with the other portions of the Everglades should be consistent with the ability to maintain flood protection and existing water supply for agricultural and urban areas.

6.4.5.2. Big Cypress National Preserve

The Big Cypress National Preserve area is a mosaic of evolving habitat types resulting from both natural and manmade forces. Historically, long hydroperiods limited the invasion of shrubs and pines into cypress forests and frequent fires prevented hardwoods from dominating cypress and pine forests. Infrequent hot fires burned holes into peat soils that created new pools. The result of these conditions was a balance of shifting successional communities. Construction of the L-28 levee, Tamiami Trail, and Loop Road altered flows and changed the habitat cycles of floods and fires.

As part of this concept, hydrological and ecological conditions will be improved by providing more historic-like flows along the eastern border of Big Cypress National Preserve. This will provide for more natural inter-annual and seasonal variations of flow that will, in turn, result in a more natural cycle of floods and fires in the area. As more natural patterns of fires and floods are restored, overall habitat heterogeneity will increase and a more natural interspersion of uplands and wetlands will return. Additional benefits of this concept may include improvements in water table elevations in the coastal mangrove forests in the Ten Thousand Islands area of Everglades National Park. Impacts to threatened and endangered species such as the Cape Sable Seaside Sparrow and the West Indian manatee will need to be considered and addressed.

The L-28 Levee presently separates Water Conservation Area 3A and the Big Cypress National Preserve. To restore hydropatterns within Big Cypress National Preserve, this levee, Tamiami Trail, and Loop Road may need to be modified. Further upstream, the L-28 Interceptor Canal (L-28I) collects water from the Seminole Reservation and upstream basins and discharges it into Water Conservation Area 3A. Allowing this canal to discharge further upstream in the northeast corner of Big Cypress National Preserve could rehydrate Mullet Slough and the headwaters of Big Cypress Natural Preserve, while still providing flood protection to the Seminole and Miccosukee Reservations. Facilities for water treatment will be necessary to improve water quality entering natural areas from the C-139 and the L-28I canals that presently flow directly into Water Conservation Area 3A. The Seminole Tribe's Water Conservation Plan provides a greater opportunity to restore more natural hydropatterns in the Big Cypress National Preserve by creating flows further north and west. Bypass structures will be placed under the West Feeder Canal on the Big Cypress Reservation that will sheetflow clean water south along the length of the west Feeder Canal into the Big Cypress Preserve Addition.

6.4.5.3. Everglades National Park

Tamiami Trail (U.S. 41) and L-29 form an ecological and hydrological barrier between Water Conservation Area 3 and Everglades National Park. Two on-going projects have identified ways to improve hydrologic and ecologic conditions within Everglades National Park; the Modified Water Deliveries to Everglades National Park and C-111 Projects. These projects will help improve conveyance into Everglades National Park and provide some seepage control south of Tamiami Trail. While these projects will improve conditions in Everglades National Park in the interim, additional measures may be needed to further control seepage and restore conveyance to historical levels. These issues need to be addressed through the Restudy and evaluated collectively. Structural modifications to the L-29 levee and improving conveyance through Tamiami Trail (bridge structure) from CR 951 to 40 Mile Bend and Loop Road need to be evaluated by the Restudy from the perspective of restoring the hydrologic and ecologic continuity of Water Conservation Area 3, Everglades National Park, the Big Cypress, and Ten Thousand Islands. .

Groundwater seepage loss is the main impediment to any kind of restoration within Everglades National Park. Its impact is far reaching, affecting every water management decision along Tamiami Trail. To address this problem, the Water Preserve Areas concept has been extended south of Tamiami Trail to control the extreme seepage losses that occur on the east side of the Park. At a minimum, the areas of concern include the 8 ½ Square Mile Area, Bird Drive Basin, and the Pennsucco Wetlands.

Flamingo Road, which is the main road through Everglades National Park, is the only road providing access to the Flamingo visitor center. This roadway acts as a levee during high flow conditions and impedes sheetflow through portions of Everglades National Park. This concept addresses improving conveyance through this road. Adding culverts, bridges, or other improvements to Flamingo Road will remove a hydrological barrier and restore more natural flows within the area, resulting in improved hydrologic and ecologic continuity.

6.4.5.4. Biscayne National Park

Large public works projects in South Miami-Dade County (e.g. U.S. 1, the C&SF Project, etc.) have interrupted natural freshwater flows into Biscayne Bay. The pending transfer of Homestead Air Force Base to Miami-Dade County, and the public acquisition of the Model Lands provide important opportunities to improve these hydropatterns. The Commission supports the sustainable conversion of the air base and redevelopment of appropriate areas in southeast Miami-Dade County as critical economic development projects. Water management changes that result from these activities must be made in ways that protect Biscayne National Park and other vital environmental resources in southeast Miami-Dade County, reconnect drained

wetlands east and west of U.S. 1, and reinforce the sustainable agricultural goals of this Commission. The reconnection of Biscayne Bay to more natural freshwater flows from the mainland will complete the "natural area continuity" at the southeastern end of the natural system.

6.4.6. Concept 6: Water Supply and Flood Protection for Urban and Agricultural Areas

The flood protection and water supply provided by the C&SF Project have facilitated the development of urban and agricultural areas in south Florida. Population growth and the intense development in south Florida are expected to continue resulting in significant increases in the demand for water and pressure to maintain and enhance flood protection. The Commission recognizes that flood protection and water supply for all users are critical components of sustainability of the region. The Commission also recognizes the continued importance of the C&SF Project to meet these needs. It is the goal of the Commission to maintain existing levels of water supply and flood protection and, where consistent with restoration goals, to balance future flood protection and water supply.

C&SF Project facilities allow the Water Conservation Areas and Lake Okeechobee to serve as a critical source of water for meeting urban needs during periods of low rainfall. This includes providing recharge to the surficial aquifer along the Lower East Coast and maintaining surface water supplies to the Caloosahatchee Basin and the West Palm Beach Water Catchment Area. In addition, the lake serves as a direct source of water for lakeside communities.

The South Florida Water Management District is currently developing four water supply plans that, together, cover the entire boundaries of the South Florida Water Management District. Each regional plan analyzes the available water supply and makes projections of future demand through the year 2010. Working with public advisory committees, the South Florida Water Management District is determining the likelihood of future water supply problems, and is developing potential solutions to these problems. The majority of the C&SF Project facilities fall within the boundaries of the Lower East Coast Regional Water Supply Plan. An interim plan was completed in early 1998. The Lower West Coast Water Supply Plan was completed in 1994. The Upper East Coast Water Supply Plan was completed in 1998 and the Kissimmee Water Supply Plan is underway. The plans will make recommendations to address immediate water supply issues and will also make long term recommendations to the Restudy.

One important option under consideration in both the Lower East Coast Regional Water Supply Plan and the Restudy is the Water Preserve Areas concept, which will benefit regional water supply. Capturing and storing excess stormwater runoff in the Water Preserve Areas could serve as additional storage areas for urban water supply and enhance recharge of the Biscayne Aquifer. Other regional concepts,

such as modification of the regional and secondary canal systems to improve water management and recharge capability are possible methods of increasing recharge to the surficial aquifer. Options that have been identified for this purpose include raising coastal canal stages (with appropriate means to maintain flood control) and interconnecting local surface water management systems and the southern L-8 Project in northern Palm Beach County.

Other alternatives, while less regional in nature, include new inland wellfields, public water supply aquifer storage and recovery, wastewater reuse, the reduction of per capita water usage, and the use of brackish or saltwater sources of water. Utility or local government programs for plumbing retrofit and landscape water conservation programs may also be useful in slowing the increase in urban demands. It is anticipated that the implementation of a combination of alternatives will be necessary, depending on the type of user and the circumstances that the user encounters. It is critical that the Restudy effort work closely with local water utility departments to further develop these alternatives. The Commission believes the Restudy must take a regional view toward water supply. Further, the Commission recognizes that regional water supply deliveries from the C&SF Project are critical to achieving sustainability. The Restudy must develop plans to mitigate and replace any water supply lost through system modifications for environmental restoration.

The C&SF Project has provided regional flood protection throughout the entire system. Flood protection provided to existing agriculture and development should be maintained. In a number of areas, some features of the Project have never been constructed and development and agriculture have occurred in areas not previously anticipated to be converted. Of particular concern is the south Miami-Dade area where projects such as the Modified Water Deliveries to Everglades National Park and the C-111 Project are underway. These south Miami-Dade projects must incorporate appropriate flood protection into their design. The Commission has identified a number of water storage options throughout the C&SF Project system that will provide increased flood protection. These options, including the Water Preserve Areas and storage areas, should also include flood protection as their purpose.

6.4.7. Concept 7: Adequate Water Quality for Natural System Functioning

A fundamental requirement for maintenance and restoration of the Everglades ecosystem, Florida Bay and the coastal estuaries is the delivery of adequate amounts of clean water. Just as restoration of water quantity in proper volumes and timing to the Everglades is the cornerstone of Everglades restoration, the Commission believes that the natural system can only be restored through the supply of clean rainwater and surface water from upstream marshes, rivers, sloughs, and Lake Okeechobee.

Drainage from the extensive agricultural development in the Everglades Agricultural Area delivered to the Everglades marsh via the C&SF Project structures resulted in the degradation of Everglades marsh surface waters. Stormwater runoff from extensive urban development on both coasts has degraded water quality in the coastal estuaries and certain portions of the Everglades where urban stormwater/drainage water is backpumped (i.e., the C-11 Basin) via the C&SF Project structures. Since the natural Everglades ecosystem is oligotrophic, with high plant biomass and very low nutrient concentrations in marsh surface waters, it is acutely vulnerable to eutrophication by elevated nutrient levels. The estuaries, notably Florida Bay, Biscayne Bay, and the St. Lucie Estuary, have been damaged by degraded water quality or unnaturally high volumes of water facilitated by the C&SF Project canals.

Large scale Everglades restoration planning and implementation must include the delivery of clean water to the Everglades marsh. Ecological restoration cannot be accomplished if water flowing to the Everglades contains high nutrients and ecologically damaging levels of pesticides, heavy metals, and other constituents. If, in the future, the Everglades marsh consists of large expanses of cattail monoculture, the ecologic integrity of the Everglades will not be equivalent to restoration of a diverse, heterogeneous system of sawgrass marsh intermingled with spikerush flats, deep water sloughs, tree islands and upland hardwood hammocks.

A number of activities are currently underway or programmed by various agencies to address the issue of water quality entering Lake Okeechobee, the Everglades, Florida Bay and the region's estuaries. These activities serve to improve the quality of water currently being discharged into lake, wetland, and estuarine ecosystems from existing water management infrastructure and are a critical and integral component of the Commission's Conceptual Plan for the Restudy. Evaluations of these water quality improvement activities must occur to insure their adequacy in meeting the goal of restoration.

The Florida Department of Environmental Protection's water quality standards program develops designated uses and classifications of State waters. Narrative and numeric water criteria are set for various water quality parameters to protect the designated use of the water body. The Everglades Forever Act mandates that the Florida Department of Environmental Protection, in conjunction with the South Florida Water Management District, develop numeric water quality criteria for phosphorus in the Everglades Protection Area by the year 2001. The development of numeric water quality criteria, particularly for phosphorus in the Everglades marsh, is a critical step in developing ecosystem-wide water quality and ecological restoration strategies. The Seminole and Miccosukee Tribes have also been delegated the authority to set water quality standards. These standards will address protection of wetlands with cypress and sawgrass communities.

Because enforcement of state narrative and numerical water quality standards is critical to protecting the ecological health of the Everglades ecosystem, the Commission recommends that structures discharging into the Everglades Protection Area be appropriately permitted, as provided by law, and that discharge effluents be monitored to ensure all applicable state and Federal water quality standards and laws are met.

Non-point source pollution associated with urban or agricultural land uses adversely impacts both groundwater and surface water resources and must be controlled in basins draining to both the Everglades Protection Area and the coastal estuaries. Specifically, non-point source pollution associated with the backpumping of untreated water into Water Conservation Area 3-A at pump structure S-9, in the C-11 drainage basin in western Broward County, must be adequately addressed and controlled by local, state and Federal water pollution control agencies.

In addition, high levels of methyl mercury have been found in fish and wildlife in Everglades marshes and canals. In Florida, the highest concentrations of mercury in fish have been found in Water Conservation Area 3A. Human consumption advisories have been issued by the State banning consumption of several fish species in Water Conservation Areas 2A, 3A and the Park, and limiting consumption in Loxahatchee National Wildlife Refuge (Water Conservation Area 1). Possible sources of mercury include atmospheric deposition, effects of drainage, soil disturbance, hydroperiod alteration and historic storage of mercury in the Everglades. An extensive interagency state-Federal mercury research program is underway to identify and quantify mercury sources and transport systems to the Everglades. The Environmental Protection Agency (EPA), DEP and the United States Geological Society (USGS) are developing models to evaluate the effect of various mercury source control and water management strategies on the Everglades mercury problem. The South Florida Water Management District and the Florida Game and Fresh Water Fish Commission (FGFWFC) are also working as part of the multi-agency effort to better understand this ecological problem and develop appropriate responses.

Florida Department of Environmental Protection and the South Florida Water Management District are also involved with numerous water quality improvement efforts throughout south Florida aimed at establishing appropriate criteria for discharges and streamlining the permitting process. These efforts are consistent with the Commission's objectives for sustainability in that they support integration of human activities with the needs of south Florida's natural resources and allow for an ecosystem management perspective.

About 700 million gallons of wastewater are treated and discharged in south Florida daily, much of it to tide. Some urban areas in south Florida have experienced problems with sewage overflow and lack of capacity. The tripling of population anticipated in south Florida in the next few decades may result in three times as

much wastewater. There must be adequate capacity to treat this wastewater to a quality that does not adversely impact groundwater or receiving surface waters such as canals, estuarine areas or near-coastal waters. In addition, if properly treated, reuse of this wastewater for appropriate purposes would help meet regional water supply needs.

In addition to areas that generate large quantities of wastewater, there are also numerous communities in south Florida that utilize on-site sewage disposal systems, such as septic tanks and cesspits, for wastewater treatment. Throughout the region, concentrations of such systems pose significant water quality problems. Replacement of these systems with centralized wastewater disposal systems or other technologies which significantly reduce nutrient impacts may be expensive, but necessary, and is often beyond the means of many of the region's small communities, particularly around Lake Okeechobee and the Florida Keys.

The Seminole Tribe's Water Conservation System Conceptual Project provides for sustainable development of their Big Cypress Reservation and balances the needs of the environment with the Tribe's needs for economic sustainability on its homeland. It provides for a network of surface water management structures and the implementation of a comprehensive system of best management practices. This effort helps the Tribe meet the numerical standard for phosphorus concentration in waters discharged from the Reservation, thereby supporting sustainable agriculture while contributing to restoration of the western Everglades ecosystem. The Seminole Tribe is also contributing to the improvement of water quality in the Western Basins through the Landowners Agreements and an Agreement with the South Florida Water Management District. The Everglades Forever Act only covers flows from the C-139 Basin and the C-139 Annex. These waters currently flow through the L-28 into Water Conservation Area 3A. Water from these basins will be diverted and treated through STA 5 and STA 6 of the Everglades Construction Project. In order to address high phosphorus inflows to the Reservation, the Seminole Tribe has entered into these agreements and will be embarking on an enhanced water quality monitoring program.

Of the 23 planning objectives developed by the Commission for the Restudy, 12 are either directly or indirectly dependent on attainment of adequate water quality conditions (see Table 6-1). Many of the concepts considered for inclusion into the Restudy require further water quality evaluation and could have either a positive or a negative influence on the Everglades. As the Restudy progresses, the water quality aspects of individual alternatives must be assessed. In particular, certain concepts give rise to opportunities to address water quality issues including: the Everglades Agricultural Area water storage concept, Water Preserve Areas, and the regional storage within the Everglades headwaters concept. The Commission also proposes specific water quality improvement projects to be considered under this concept including water treatment facilities for the Kissimmee River, Caloosahatchee River, S-9, C-111, and L-28 Interceptor Canal.

6.4.8. Concept 8: Increased Spatial Extent and Quality of Wetlands Beyond the Everglades

Roughly 50 percent of the Everglades have been destroyed by land conversion to agricultural, urban, and industrial development. They continue to be lost through wetland permitting programs. Wetland loss has reduced landscape heterogeneity, eliminated habitat of wetland dependent species, and threatened the long-term viability of vertebrate species that require extensive territory (e.g., wading birds and panthers). The protection and restoration of wetlands outside the publicly owned lands, not just the Everglades, could substantially increase success in reestablishing many native communities. This concept focuses on the protection and restoration of existing wetlands including smaller, isolated wetlands not contained in the remnant Everglades. It includes ongoing restoration efforts, such as the wetland conservation strategies and multi-species recovery planning, as well as additional efforts that address the Commission's objective for increasing the spatial extent and quality of wetlands. A regulatory permitting strategy coupled with a land acquisition program for the remaining wetlands is needed immediately to ensure their values are protected and restoration opportunities are not precluded.

The State of Florida's Conservation and Recreation Lands and Save Our Rivers Programs use bond proceeds, supported by the general revenue portion of the State's Documentary Stamp Tax, to acquire lands for the purposes of water management, water supply, and the conservation and protection of the State's water resources. Manageability, surface and groundwater systems, and the formation of corridors for the critical interaction of wildlife populations are major considerations in this land acquisition process. Prime requisites in managing these public lands continue to ensure water resources, fish and wildlife populations, and native plant communities are maintained in an environmentally acceptable manner, and that they are made available for appropriate outdoor recreational activities consistent with their environmental sensitivity.

The Kissimmee River, once a meandering river with associated marshlands that provided water storage for the Everglades system and habitat for birds, fish, and wildlife, was channelized into a 56-mile ditch (the C-38 Canal) as part of the C&SF Project. Channelization drained approximately 20,000 acres of wetlands. The Corps and the South Florida Water Management District are currently restoring portions of the Kissimmee River's floodplain.

Two areas of the Kissimmee River not presently under consideration for restoration, but supported by the Commission, are Pool A and Paradise Run. Pool A is situated south of Lake Kissimmee. The existing C-38 flood control channel there will remain in place to ensure flood protection in the Upper Chain of Lakes. Flow-through marshes, encompassing approximately 3,000 acres, could be created to improve the quality of water delivered southward and to restore additional high quality floodplain

wetland habitat. Paradise Run, 8.5 miles in length, lies immediately north of Lake Okeechobee and west of the old Kissimmee River channel. It now consists of 1,200 acres of wetlands. The restoration of Paradise Run would result in more natural hydrologic conditions and improved habitat for fish and wildlife resources, and would add an additional 2,200 acres of high quality floodplain wetlands.

The Herbert Hoover Dike was built around portions of Lake Okeechobee in the 1930s, largely as a consequence of the 1926 and 1928 hurricanes. The C&SF Project completed the impoundment of the lake in the 1950s and 1960s. This impoundment separated large natural areas located adjacent to the northern, western, and, to a more limited extent, the southern portion of the lake from their connection to the lake. These areas, once upper elevation marshlands, are drier than they were historically and no longer function as they once did. Wetland enhancement to areas that once formed the littoral system would contribute to the quality of fish and wildlife habitat. Any activities related to this restoration need to consider impacts to the Seminole Tribe's Brighton Reservation on the northwest side of Lake Okeechobee.

Kreamer, Torry, and Ritta Islands, located in the southern end of Lake Okeechobee, were formerly used for agricultural purposes. The restoration of these islands would involve degrading selected levees to allow more natural water levels and transplanting native vegetation. These actions would not affect existing private properties. They could result in additional habitat for water birds, fish, and other wildlife. Contaminant studies need to be completed prior to restoration design.

The Big Cypress Basin provides freshwater to the coastal marsh and mangrove communities of the southwestern Everglades. Construction activities associated with the defunct Golden Gate Estates development has altered the basin's natural drainage patterns through over-drainage and has affected biologic habitat and natural hydropatterns. Restoration of the southern portion of the Golden Gate Estates (between I-75 and Tamiami Trail) would restore sheetflow over an area of 113 square miles. This, in turn, would improve habitat quality and heterogeneity, notably for the endangered Florida panther, reduce the incidence of destructive wildfires, and improve the quality and timing of freshwater discharges to Faka Union Bay, Pumpkin Bay, Rookery Bay, Ten Thousand Islands, and Naples Bay.

The areas along the Lower East Coast are generally included in the Water Preserve Areas concept and should be carefully examined to ensure remaining areas are preserved or restored, where feasible. The Model Lands Basin that is located in southern Miami-Dade County is one such area. It is predominately east of U.S. 1 and encompasses approximately 79,000 acres. U.S. 1 and Card Sound Road have impeded the flow of water to the basin, impacting wetland habitat and necessitating discharges to downstream bays. Restoring hydrologic connections and functions to the Model Lands, including improving the hydrologic connections under U.S. 1, would not only improve the functional quality of these wetlands, but would also help restore Barnes

Sound, Card Sound, and Biscayne Bay. Additionally, it would complete a contiguous wildlife corridor stretching from the basin southward to the Florida Keys National Marine Sanctuary. Similarly, the Pennsucco wetlands, west of the Dade-Broward levee in northwestern Miami-Dade County, are peripheral wetlands used by foraging wading birds, including endangered species. Management of the Pennsucco wetlands, the final footprint of which is being considered by the Northwest Dade County Freshwater Lake Implementation Committee, should include maintaining and enhancing the habitat and foraging benefits of this area for wildlife.

The South Florida Ecosystem Restoration Working Group, the Chair of the Governor's Commission, and the Miami-Dade County Commissioners have supported the need to protect open spaces and wetlands that serve vital hydrologic functions for Biscayne Bay. This refers to lands between Biscayne National Park and Miami-Dade County's present Urban Development Boundary. These lands are all that remain of once vast coastal uplands, prairies, and wetlands in the Biscayne Bay Basin that filtered, conditioned, and dispersed freshwater flowing east into Biscayne Bay. These lands have been drastically reduced in area and in hydrologic integrity. The protection and hydrologic improvement of these areas is needed to sustain agriculture and the marine systems of Biscayne National Park.

6.4.9. Concept 9: Invasive Plant Control

Non-native ("exotic") plant species, such as melaleuca, Australian pine, Brazilian pepper, torpedo grass, and hydrilla have invaded large portions of the south Florida ecosystem. This occupation resulted in the displacement of native species and/or the degradation of habitat essential to native plants and animals. Melaleuca is especially damaging because of its high rate of evapotranspiration compared to native grasses that may contribute to lowering water levels in the Everglades and Lake Okeechobee. Aerial and other types of surveys reveal the proliferation of exotic plants has resulted in the formation of melaleuca monocultures in some areas of the Water Conservation Areas. Surveys also show their occurrence throughout most areas east of the Water Conservation Areas, particularly those that may be included as Water Preserve Areas. Even when these plants do not occur in natural areas, they act as seed sources and pose a threat to natural areas. Control or eradication of invasive exotic plants is necessary to improve and protect habitat quality and heterogeneity.

This concept includes the development and evaluation of methods to control invasive (exotic) plants throughout south Florida, the application of these methods to control exotics within the C&SF Project area, and the establishment of success criteria combined with appropriate biological monitoring. Successful control of exotic pest plants depends on the formation of cooperative intergovernmental and public/private partnerships.

Existing methods to remove invasive exotics are being used throughout south Florida. These methods include mechanical harvesting, application of herbicides, and use of biological agents. Because extensive use of herbicides is contrary to water quality improvement, alternative methods, such as biological controls, need further investigation or testing on a trial basis.

While past and present invasive exotic eradication activities have been limited, it appears that future activities may be further reduced because of Federal budgeting priorities. The Commission believes that a comprehensive invasive exotic plant control program that includes monitoring activities designed to map the distribution and abundance of exotics throughout south Florida must be developed and implemented to control and eventually remove invasive exotics from natural habitats. Additionally, melaleuca should be added to the Corps' list of invasive aquatic plants so that funds can be allocated for its control. The use of volunteers, analogous to the University of Florida's Institute for Food and Agricultural Science's Lake Watch program, should also be considered as part of a sustained eradication strategy.

The Science Subgroup of the South Florida Ecosystem Restoration Working Group, in their November 15, 1993, report, recommended that short hydroperiod wetlands should be reestablished. The Restudy process should investigate the role of short hydroperiod wetlands in south Florida natural system restoration and, if additional short hydroperiod wetlands are determined to be necessary, their location and spatial extent must be determined.

6.4.10. Concept 10: Aquifer Storage and Recovery

This concept addresses the potential use of Aquifer Storage and Recovery technology as a means of storing water in aquifers for future use. Water is injected into an aquifer during periods of surplus for later recovery during dry periods. Storing water in an aquifer, such as the upper Floridan, using Aquifer Storage and Recovery technology may provide greater storage efficiency when compared to the land requirements and high seepage and evapotranspiration rates associated with above ground reservoir storage. Areas that could potentially benefit from Aquifer Storage and Recovery include the Everglades Agricultural Area, the Caloosahatchee Basin, St. Lucie Basin, Lake Okeechobee and the urbanized lower east coast. Aquifer Storage and Recovery technology should be investigated to determine its feasibility at a regional scale, as well as its environmental impacts.

Water quality concerns, particularly regarding untreated surface water, currently limit the ability to use Aquifer Storage and Recovery. Aquifer Storage and Recovery should be tested to evaluate technical uncertainties with high capacity applications (GCSSF, 1996a). In planning a pilot study for large-scale Aquifer Storage and Recovery, several issues need to be addressed. These include environmental and

health concerns regarding water quality, current regulatory constraints, costs of the project, and potential benefits of having additional clean water at the chosen site.

Potential locations for Aquifer Storage and Recovery pilot projects include sites on the fringe of Lake Okeechobee, to store excess lake water that would either be lost through discharge to tide or create harmful, prolonged high water conditions in the lake's 100,000 acre marsh. Since the higher lake regulation schedule was fully implemented in 1979, discharges to the estuaries have exceeded 400,000-acre feet in 10 of the following 17 years. During six of those years, discharges exceeded 1,000,000-acre feet; during two years discharges exceeded 2,000,000-acre feet; and during one year discharges exceeded 3,000,000-acre feet. Damaging prolonged high water levels also covered the lake's marsh for a number of those years. When the rain comes, we cannot refuse to accept it. When the lake rises to damaging or dangerous levels, our current choices are limited to accepting damage to lake's marsh, or the estuaries, or both. If the goals of protecting the estuaries and the lake's marsh, while improving the quality, heterogeneity, and expanding the spatial extent of Everglades system natural habitats are to be achieved, development of alternative water storage methods for the massive amounts of water entering Lake Okeechobee is vital.

Current water supply demands are projected to increase to meet environmental goals and expanding water supply needs. There is also a need to both protect the lake's marsh and to establish minimum levels for natural waterbodies. Storage of excess water during years of surplus for use during drought years will become increasingly important. Acquiring sufficient lands to hold all of an average year's estuarine discharge is cost prohibitive. Using Aquifer Storage and Recovery in combination with Everglades Agricultural Area storage has the potential to store large amounts of water at its source and close to the demand while protecting the ecological health of the estuaries and the lake. A proposed Aquifer Storage and Recovery project utilizing Lake Okeechobee water is currently under review by the U.S. Environmental Protection Agency and Florida Department of Environmental Protection. The Commission supports this pilot project.

The possibility of conducting pilot projects at other sites, using other aquifers, should also be considered. Sites within the Lower East Coast which could store, in the upper Floridan aquifer, water taken from the Water Preserve Areas should also be considered. If large-scale Aquifer Storage and Recovery is shown to be feasible, more extensive regional scale facilities utilizing untreated surface water runoff and Lake Okeechobee discharges could be beneficial in meeting additional demands within the region. Detention facilities or canals that intercept and hold excess water for injection into the aquifer may be required at some sites. The quality of untreated stormwater runoff may preclude its injection for Aquifer Storage and Recovery purposes under current regulations

Regional scale Aquifer Storage and Recovery facilities could be beneficial in meeting demands in the Caloosahatchee River and St. Lucie River Basins, or other basins. Water quality concerns would also be present in these areas. Regional scale Aquifer Storage and Recovery in association with the Water Preserve Areas has also been proposed for western Miami-Dade, Broward, and Palm Beach Counties. The source of water would be surface water backpumped into the Water Preserve Areas or canal flow. Utilization of Aquifer Storage and Recovery in these areas may increase the storage capability of the Water Preserve Areas and provide more urban water supply benefits for these areas. The feasibility of Aquifer Storage and Recovery in association with the Water Preserve Areas may be limited due to many of the same water quality concerns that face projects using untreated surface water in other areas. The Commission recognizes that water injected into the aquifer may not meet appropriate water quality standards. Water recovered from the Aquifer Storage and Recovery system may not have the appropriate quality for its intended use. A final consideration is that Aquifer Storage and Recovery facilities are most useful at the site of water treatment plants, where clean treated water can be injected, plant operation economies can be realized, and conveyance losses can be eliminated.

6.4.11. Concept 11: Protection and Restoration of Coastal, Estuarine, and Marine Ecosystems

Florida's estuaries and bays have been harmed by human alterations to the ecosystem within the last 50 years. Without drainage canals to divert storm and surface waters, development in low-lying coastal areas would never have been possible. Unfortunately, too much water is diverted too efficiently. Untreated stormwater is rapidly funneled out to sea through the estuaries instead of being stored in wetlands. What remains of the inland marshes seldom receive their full share of water. Estuaries suffer from a glut of freshwater following heavy storms and a lack of freshwater when not enough water is stored in the system to make it through Florida's dry winters and periodic droughts.

These alterations have radically changed the volume, timing, and quality of freshwater flow to south Florida's estuaries. From the Indian River and St. Lucie estuaries to the Biscayne and Florida Bays, the Ten Thousand Islands to the Caloosahatchee tidal river estuary, the quality of estuarine habitat for fish and other marine resources has been affected by freshwater flow changes associated with the C&SF Project and other water control efforts (e.g., the Golden Gate Estates canal system). In general, channelization decreases the time lag between rainfall and runoff. This increases the rate of flow to certain downstream estuaries during the wet season and decreases the flow during the dry season. Estuarine life is negatively impacted both by the wet season excesses and the extended dry season deficiencies. Surface water also permeates the soil and becomes groundwater, whose quantity, quality, and distribution is equally important to coastal systems, such as Biscayne and Florida Bays. An extreme example of this problem is in the upper Ten Thousand Islands, where 200 square miles of the Big Cypress wetlands is channelized into Faka Union

Bay. Freshwater flow has been diverted away from Florida Bay and the mangrove estuaries of the Lower Southwest Coast (e.g., Whitewater Bay), possibly resulting in both wet season and dry season deficits. In the St. Lucie and Caloosahatchee Estuaries, regulatory releases from Lake Okeechobee have exacerbated the problems of excess flows.

Water quality in the Keys and on the reef tract is declining due to macro-scale regional development in south Florida, the diversion of water away from Florida Bay, and detrimental water quality activities locally and regionally. Over the years, the cumulative effect of these changes is catastrophic. Murky water and algal blooms have replaced the clear waters of Florida Bay. Similar degradation is occurring in northern Biscayne Bay. The highly productive seagrass beds and fisheries of the St. Lucie and Caloosahatchee Estuaries, as well as Florida Bay, are now in decline as a result of dramatic fluctuations of freshwater input into estuarine and marine waters. Diseases and eutrophication threaten the coral reef systems of the Florida Keys. The Commission places a high priority on protecting and restoring south Florida's coastal and marine ecosystems, not only for their intrinsic value, but for protecting the fisheries, the fishing and tourist industries, and the characteristic south Florida lifestyles that depend on nature's bounty. Understanding the linkage between the lower watersheds, the Ten Thousand Islands, and Florida Bay is critical to developing solutions that provide for sustainability of the Keys.

The Florida Keys, including Florida Bay and the offshore coral reefs and sea grasses, are a threatened resource of international significance. In response to the Governor's Executive Order directing public agencies to take action to improve environmental conditions in the Keys, a carrying capacity study of the Florida Keys has been initiated by the Corps with funding provided by the Florida Department of Community Affairs. The study will result in an information base upon which informed development and infrastructure investment decisions can be made to achieve a balance between the economic and environmental needs of the area. Research activities in Florida Bay are being coordinated by the Florida Bay Program Management Committee. The Program Management Committee has developed the Florida Bay Research Plan and is utilizing adaptive management in the implementation of that plan. Although numerous research and monitoring activities are currently underway in Florida Bay by a variety of governmental agencies and private organizations, a process to collectively evaluate the information and develop a comprehensive plan of action is not currently planned or programmed. A program is needed to ensure effective coordination of all efforts in Florida Bay, identify all the problems and their sources, and develop a plan of action and implementation process. A comprehensive literature search and data analysis will serve to ensure that all activities influencing the bay are identified and that adequate monitoring activities are implemented. The program should also include analyses that give sufficient consideration to any improvements of current state and Federal water quality standards that may be needed to achieve the Commission's goal of sustainability.

The programmed and proposed projects that form previously described concepts of the Commission's Conceptual Plan for the Restudy involve restoring appropriate freshwater flows to bays and estuaries to protect natural salinity gradients, restore water clarity and quality, and improve water supply through management changes within the south Florida Region. The Florida Bay Emergency Interim Plan (Taylor Slough Demonstration Project), the C-111 Project, Modified Water Deliveries to Everglades National Park Project, the Lake Okeechobee Operational Plan, and the creation of water storage areas in the Water Preserve Areas, Caloosahatchee Basin, and the Upper East Coast area will help protect the region's coastal estuaries from the detrimental effects of excessive stormwater runoff and will improve essential baseflow of freshwater during dry seasons. Projects identified as part of the regional Surface Water Improvement and Management plans will serve to improve the quality of water delivered to the coastal areas through development and implementation of best management practices for agricultural and development activities, retrofitting of existing stormwater management facilities to reduce pollutant loads, and elimination of sewage effluent discharges and septic tank impacts. The various regional Surface Water Improvement and Management plans need to be integrated and coordinated with other adjacent local restoration efforts such as those for the Miami River and the New River.

Other major projects underway to achieve the Commission's goals for sustainability include the development of hydrodynamic circulation models for Biscayne Bay and Florida Bay. A hydrodynamic model of Florida Bay is under development for use in simulating water movement patterns in the Bay. Among other things, the model will enable salinity predictions from varying temporal and spatial freshwater inflows. The Florida Bay model will accept output from the hydrologic models used to predict overland flows to determine the impacts that the modifications and operational changes to the C&SF Project will have on Florida Bay. (Often, the hydrologic models can predict the volume and location of flows across the mangrove zone.) The model will be multi-dimensional, allowing two dimensional vertically averaged calculations at a minimum, and perhaps some three dimensional calculations where stratification is evident. The hydrodynamic model will be linked with a water quality model. Development of a mathematical computer simulation model system for Biscayne Bay is currently underway as a first step to investigate the effects of the C&SF Project on water circulation and salinity patterns. This effort must be further developed to assess impacts to biological communities and water quality in the Bay. The South Florida Water Management District developed a one-dimensional hydrodynamic model that predicts salinity throughout the St. Lucie Estuary under various inflow conditions from the watershed. This model was used to identify a salinity range that is favorable to the development and maintenance of a healthy estuarine ecosystem. This effort must be further developed and expanded to assess the C&SF Project freshwater discharge impacts on the Indian River Lagoon. These model efforts are essential to the identification of existing conditions and the evaluation of

the effects of any proposed modifications to the C&SF Project on these important coastal resources.

6.4.11.1. Sediment Removal and Control in Estuaries

Accumulated organic sediments have been deposited in the Caloosahatchee and St. Lucie Estuaries. Organic sediments settle out in the estuaries as a result of sediment runoff and the interaction between fresh and estuarine water. These organic sediments deplete the dissolved oxygen and degrade water quality through resuspension during periods of physical disturbance. Removal of these sediments could improve water quality and possibly expose coarse-grained substrate suitable for aquatic plant growth along the littoral shelf of the estuaries. Small scale pilot projects should be implemented to determine the feasibility and environmental effects of muck removal or stabilization from the St. Lucie Estuary.

A report on a potential muck removal demonstration project for the St. Lucie Estuary was previously completed. The report recommended that further studies be conducted prior to proceeding with a demonstration project. The report concluded that large scale sediment removal may improve water quality by reducing re-suspension of fine sediments and would reduce oxygen demands in the water column, assuming upstream sediment sources were eliminated.

The St. Lucie Canal was constructed in the 1920s by the Everglades Drainage District. The canal banks are unstable in a number of areas along the length of the canal and material from the banks that sloughs off is transported and deposited as shoals in the St. Lucie Estuary. Stabilizing the canal banks with rip-rap, or reshaping and restoring vegetation on the canal banks could reduce the sediment loading to the estuary. The Restudy should include an analysis of the bank erosion and its impacts to the estuary. It may be possible to acquire additional rights-of-way and reshape the canal banks to create a functional littoral zone. Such projects could reduce erosion and produce other benefits such as water quality and habitat improvements. Additional study will be necessary to evaluate and quantify the benefits to the estuary from environmentally sensitive bank stabilization measures.

6.4.12. Concept 12: Conservation of Soil

Conservation of soils in the agricultural areas bordering the Everglades increases the opportunity for long-term sustainability of agriculture and natural areas. In particular, organic soil subsidence, caused by man's drainage facilities including the C&SF Project, is adversely impacting natural areas and agriculture in south Florida. Subsidence is created by a number of factors, including the oxidation of organic soils resulting from lowered water tables for extended periods of time, fires, wind erosion, and peat shrinkage.

In the Everglades Agricultural Area, soil loss has diminished the higher ground elevations that maintain the hydraulic head which drives water south. In some areas more than eight feet of organic soil was lost by 1984. Soils continue to oxidize; however, Best Management Practices should slow down the rate of oxidation. Some areas in the southern Everglades Agricultural Area, where shallow soils overlie bedrock, already have less than two feet of soil remaining. As soils subside, the movement of stormwater out of the area requires increased pumping. Soil conservation is also important in southern Miami-Dade County, where agriculture still forms a vital part of the local economy as well as a buffer between urban development and the natural system. In this area, soil conservation and sustainable agriculture programs will enhance the long-term viability of the ecosystem.

Research has shown that if soil moisture content of the organic soils is maintained for longer periods of time throughout the year, soil subsidence can be significantly reduced. Limited research is now underway to develop sugar cane varieties that can tolerate higher water levels, yet maintain an acceptable yield. These types of crops, some conversion to traditional wet-pasture beef cattle production, aquaculture, rice production, best management practices, and improved water management may significantly increase the long-term sustainability of agricultural activities in the Everglades Agricultural Area.

Increasing groundwater levels in the Everglades Agricultural Area will reduce the overdrainage that has caused the oxidation of organic soils. Under this concept, rainfall during the wet season will reduce the need for water from Lake Okeechobee to be used in maintaining these higher water tables. This should result in benefits to the natural system, including increased water storage in the Everglades Agricultural Area, decreased vulnerability to floods, and decreased necessity to send large pulses through the east coast and west coast estuaries. Further, water quality should be improved by reducing phosphorus inputs from oxidation and erosion of the soil through application of best management practices and maintenance of higher water tables.

Soil subsidence has also impacted portions of the natural system. Restriction and diversion of natural sheet flow has overdrained portions of the Water Conservation Areas, the Holey Land and Rotenberger Wildlife Management Areas resulting in areas of major subsidence. Overdrainage has also caused additional soil loss as a result of severe muck fires. In addition, tree islands have been destroyed through such soil loss. As soil elevations are altered, water levels change and the associated biological community is altered. Restoration of more natural flows and hydropatterns in the Everglades, Holey Land and Rotenberger Wildlife Management Areas and other natural areas should control the subsidence and potentially reverse the trend by creating conditions favorable to the accretion of peat soils.

The goal of current public and private research efforts is for modified water management to provide conditions enabling soil accretion rather than soil oxidation. This soil conservation activity, in both natural and agricultural areas, can serve as a measure of both the environmental and economic sustainability of restoration efforts. Opportunities exist to expand on these research efforts through public/private partnerships.

6.4.13. Concept 13: Operation, Management, and Implementation of the C&SF Project Modifications and Related Lands

The south Florida ecosystem is a water-driven system encompassing a massive, unique, and fragile natural system that is also home to five million human inhabitants. The C&SF Project provides a physical and operational framework around the south Florida ecosystem that offers options for managing the natural functions of the Everglades and other natural areas. The C&SF Project also provides other benefits, including flood control and water supply for the human population of south Florida. The interconnection of the C&SF Project, both within and without its boundaries, cannot be ignored for its contributions and complexity. This Project is a multi-purpose public works system that has inherent conflicts among the competing priorities of water management.

The Commission seeks to maximize the benefits of the C&SF Project while reducing the problems it has caused. In addition to the structural changes to the C&SF Project as expressed in the 40 options, and the other 13 thematic concepts, new operational and management measures for the system will be required. How the system is managed hydrologically affects virtually every aspect of the south Florida ecosystem. This suggests that the operational changes throughout the system are critical and thus require specific attention during the Restudy. The Restudy must incorporate the best available research and modeling to ensure the multi-purpose objectives are balanced and maximized. Effective monitoring programs must be developed that allow for the implementation of adaptive management strategies to ensure that the Commission's objectives are met.

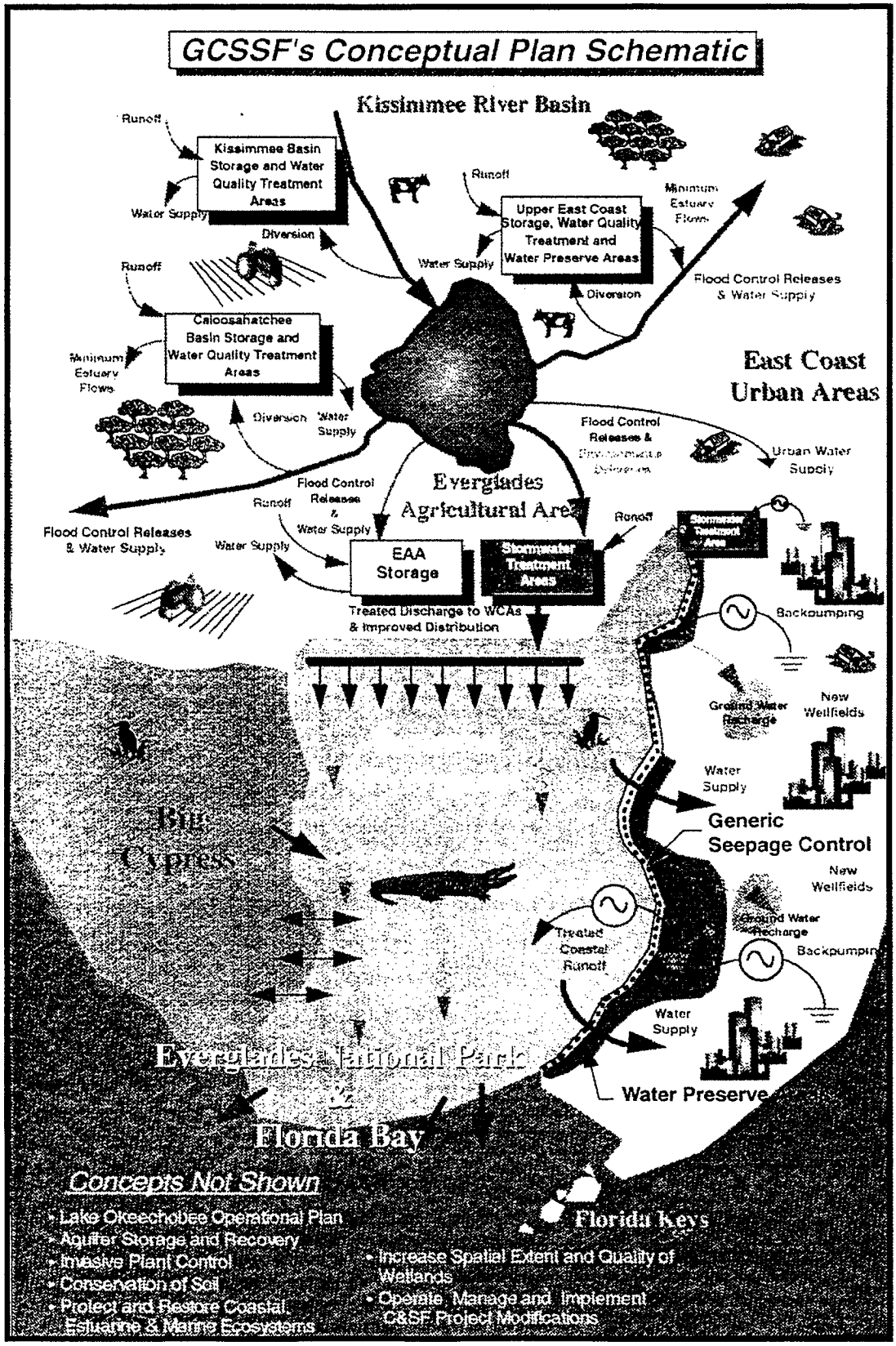
Where project operations are expected to affect lands (and their associated communities) being protected and restored as natural wetlands, operational planning needs to be consistent with sound biological science. Adequate provision is needed for monitoring biological impacts, especially where these operational changes may affect recovery efforts for endangered species and the protection of sensitive habitats.

As a first attempt to restore hydrology in Everglades National Park, a rainfall-based plan for water deliveries has been developed and implemented. A rainfall-based plan is a delivery formula that delivers water to natural areas based on antecedent climatic conditions. The Restudy should investigate the potential use of rainfall-based delivery formulas to determine if natural areas, including the Water Conservation Areas, and estuaries, can benefit from such operational changes to water deliveries.

Further, the Restudy and other efforts to provide for the sustainability of the south Florida ecosystem will ultimately determine both the extent of lands needed for the Project and the management of these lands. Rapid development of some areas of south Florida is limiting the ability to fully implement these modifications to the C&SF Project, which are needed for sustainability. As a result, the Commission has recognized the need to expedite certain land acquisitions prior to final planning and design of the modifications to the C&SF Project. Because lands are such a critical component to all restoration efforts in south Florida, recent Federal funding was provided to expedite implementation of potential project features. This has required the Commission and other decision makers to prejudge certain land acquisition projects without having all the scientific and engineering analyses completed. Acquisition of these identified priority lands should be limited to voluntary/willing sellers. Careful consideration must be given to determine the potential uses of the lands and, to the extent possible, the justification for acquisition of these lands should be based on available science.

Once acquired, these lands must be managed to meet the environmental and economic needs of the region. Meeting these needs will require the inclusion of advanced planning and land management strategies as part of the acquisition process. Such planning will ensure that the lands are properly utilized and managed consistent with the intended objectives. For example, one mechanism to help promote economic sustainability of the region would be to return agricultural lands back to agriculture, so long as such use does not conflict with long-term land use/management objectives, until a final project design utilizing these lands is completed. Therefore, these lands could be secured at an overall lower cost with less disruption to the south Florida economy.

FIGURE 6-1



C—098029

C-098029